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ABSTRACT

A series of 5 studies, involving 10 special education elementary teachers in a rural educational cooperative, examined teacher efficiency in employing repeated, curriculum based measurement of individualized education program goals. The first study established a baseline rate of teacher efficiency; the next three studies examined the effect of alternative measurement strategies on that efficiency; a final study followed up the efficiency of these teachers 1 year after training and contrasted their efficiency with the efficiency of a group of teachers who had been trained differently. Single case experimental designs and descriptive statistics were employed. Results indicated that measurement activities were time consuming for teachers at first, but that systematic procedural changes did improve the teachers' efficiency. Additionally, the followup study revealed that teachers who were trained directly had improved their efficiency by the end of the year, while teachers trained primarily by means of manuals had reduced their efficiency. This suggested that face to face training procedures might affect initial teacher efficiency as well as improvement in efficiency over time. (Author)

University of Minnesota

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Abstract

A series of five studies examined teacher efficiency in employing repeated, curriculum-based measurement. The studies involved a group of 10 special education teachers in a rural educational cooperative. The first study established a baseline rate of teacher efficiency; the next three studies examined the effect of alternative measurement strategies on that efficiency; a final study followed up the efficiency of these teachers one year after training and contrasted their efficiency with the efficiency of a group of teachers who had been trained differently. Single case experimental designs and descriptive statistics were employed. Results indicated that measurement activities were time consuming for teachers at first, but that systematic procedural changes did improve the teachers' efficiency. Additionally, the follow-up study revealed that teachers who were trained directly had improved their efficiency by the end of the year, while teachers trained primarily by means of manuals had reduced their efficiency. This suggested that face-to-face training procedures might affect initial teacher efficiency as well as improvement in efficiency over time.

Teacher Efficiency in Continuous Evaluation

of IEP Goals

Since the passage of P.L. 94-142, and with the increasing demand for accountability in the schools, educators have been required to support empirically their decisions that affect handicapped students. In attempting to accomplish this, both practitioners and researchers have become increasingly aware of the need for psychometrically sound testing that is directly relevant to classroom instruction (Tyler & White, 1980).

Frequent curriculum-based testing along with time-series analysis of data has received increased attention in the past decade as a means of formulating and documenting decisions that affect handicapped students (Jenkins, Deno, & Mirkin, 1979; Lovitt, 1977; White & Haring, 1980). Repeated measurement of academic behaviors has several psychometric advantages over pre-post administration of standardized achievement tests (Fuchs & Deno, 1981). Frequent direct testing has content validity with respect to a student's curriculum and appears to affect positively student achievement (Haring & Krug, 1975; Haring, Maddux, & Krug, 1972; Jenkins, Mayhall, Peschka, Townsend, & Krug, 1974; Mirkin, Deno, Tindal, & Kuehnle, 1979).

Unfortunately, teachers commonly report that repeated measurement procedures are time consuming (Deno, 1980), and practitioners often fail to collect data according to predesignated time schedules (Mirkin, Fuchs, Tindal, & Deno, 1981). Therefore, the purpose of this series of studies was first to determine how time consuming direct, repeated measurement procedures are, and second to explore strategies that might render these procedures more time efficient and satisfactory for teachers and that

might increase the likelihood that teachers will adhere to measurement schedules.

The research presented here was conducted as part of a maj - study of continuous evaluation of IEP goals in a rural Special Education Cooperative, and it is segmented in this report into five studies. The first study was designed to establish a baseline rate of teacher efficiency in employing repeated measurement both in a simulated and in a natural setting. In establishing these baseline rates, teachers were taught the measurement procedures and then required to observe their own measurement activities in order to increase the number of observations sampled and thereby to formulate more reliable estimates of teacher efficiency. A by-product of Study 1, consequently, was an assessment of whether teachers can reliably observe their own measurement activities.

The next three studies in this report examined the effects of various logistical arrangements on teacher efficiency and teacher satisfaction in order to determine whether the feasibility of frequent measurement can be enhanced. The final study was a follow-up of teacher efficiency in the school district in which Studies 1 through 4 were conducted, as well as a contrast of this efficiency with that of teachers who had been trained differently in the use of the same measurement procedures.

Method

Subjects

In all five studies, subjects were 10 special education elementary

resource teachers (2 male, 8 female), in a rural educational cooperative who were required by their special education director to participate in the studies. Their teaching experience ranged from 0 to 10 years. Additionally, in Study 5, a contrast group of six female teachers in a suburban school district volunteered to serve as subjects.

Teacher Efficiency

Teacher efficiency was one of the dependent measures used in all studies. It was categorized into "teacher time" and "student transition to task time."

Teacher time. For this first category, the dependent data reflected the amount of time engaged in the measurement of reading, spelling, and written expression. For initial observations, the reading measures consisted of (a) one-minute samples of correct words and errors on reading passages randomly selected from a basal reader, and (b) one-minute samples of correct words and errors on lists of isolated words randomly selected from the core list in Basic Elementary Reading Vocabularies (Harris & Jacobson, 1972). The spelling measures were one-minute samples of correct letters in sequence for words dictated from lists of isolated words randomly selected from the core list (Harris & Jacobson, 1972); the written expression measures were three-minute samples of words written in response to story starters. For subsequent observations, the measures were similar, but developed by teachers after they had been trained to do so. These measures were based on their own curriculum materials.

The dependent data for the "teacher time" category were operationalized into four behavior categories (see Observation Recording Sheet in Appendix). The first category was "preparation while student was not present." While the student was not present, the teacher found and

selected student sheets, teacher sheets, graphs, and necessary equipment (stopwatch, pencils, acetate sheet, grease pencil, etc.). The teacher also put away materials while the student was not present. To time this preparation, the observer began a stopwatch as the teacher first touched materials in preparation for measurement. The observer continued to time through minor interruptions, but stopped timing for major interruptions such as phone calls, teacher/principal interruptions of preparation time, and so on. Timing was done as the teacher put away student materials. The observer stopped the timer as the teacher finished preparation. At this point, the observer recorded the number of students for whom materials had been prepared and put away.

The second behavior category for "teacher time" was "preparation while student was present." While the student was present, the teacher found and selected stimulus materials, response sheets, graphs, and necessary equipment (stopwatch, pencils, acetate sheet, grease pencil, etc.). The teacher also put away materials while the student was present. To time this activity, the observer began a stopwatch as the teacher first touched materials in preparation for measurement. The observer continued to time through minor interruptions but stopped timing for major interruptions such as student fights, student temper tantrums, principal visits, etc. The observer also timed as the teacher put away materials. The observer stopped the timer as the teacher finished preparation. Again, the observer indicated the number of students for whom materials had been prepared.

The third behavior category was "directions." The teacher provided instructions to the students for the measurement task. To time this,

the observer began a stopwatch as the teacher initiated instructions; timing was terminated as the teacher finished giving instructions to the student.

The fourth category was "scoring and graphing." After administering the test, the teacher scored and graphed student performance. To time this, for each academic behavior measured, the observer began a stopwatch as the teacher began scoring; the observer stopped the timer immediately after performance was graphed.

Student transition to task time. The second category of teacher efficiency reflected student efficiency in transitioning back to normal classroom activity. This was estimated by teachers on a self-report questionnaire. (See Student Transition Recording Sheet in the Appendix.) On this questionnaire, teachers estimated how long it took the student to begin a new activity after completing measurement and the number of times the teacher reminded the student to begin his/her new activity.

Teacher Satisfaction

Teacher satisfaction was measured using self-report surveys. Two types of surveys, designed to tap two aspects of satisfaction, were conducted. The first measured teacher satisfaction with the efficiency modifications immediately following the experimental phases. The second obtained information on actual teacher practices several weeks following experimental phases. (See Teacher Surveys in the Appendix.)

Study 1: Efficiency of Procedures and Reliability of Self-Observation

Procedure

Two workshops were held to train teachers. At the first workshop,

teachers were taught to organize, administer, and score and graph academic measures that had been prepared and organized into a "Kit." The "Kit" is Part 1 of the Institute for Research on Learning Disabilities (IRLD) Direct and Repeated Measurement Package, designed to train teachers to select and implement a repeated measurement system for the purpose of monitoring students' academic progress and evaluating the success of different teaching strategies. The "Kit" provides the teacher with four weeks of measurement materials in reading, spelling, and written expression to be implemented before the teacher selects his/her own measurement format.

For this study the teachers performed several activities using (a) the IRLD "Kit," (b) a stopwatch worn around the neck, and (c) information about the age-grade and instructional levels in each domain for a student. The teacher's activities were:

1. Preparation of all the measurement materials for that day in reading, spelling, and written expression. She/he:
   (a) Selected all materials required for the measurement tasks.
   (b) In pencil, wrote the student's name on the student and the teacher sheets.
   (c) For all students, put these materials in a folder onto which an acetate sheet and grease pencil had been permanently attached.
   (d) Placed the folder on the table where the measures were administered.
2. Calling the student to the table and measuring the student's behavior.
   (a) For reading words in isolation, she/he:
      (1) Found the student sheet and placed it facing the student.

(2) Found the teacher sheet, covered it with the acetate sheet, and placed it facing the teacher.

(3) If necessary, read the measurement directions that had been taped to the back of the clipboard.

(4) Administered the task.

(5) Put away the student sheet.

(6) Scored and graphed student data.

(7) Erased the acetate sheet.

(b) For reading words in context, she/he:

(1) Found the student sheet and placed it facing the student.

(2) Found the teacher sheet, covered it with the acetate sheet, and placed it facing the teacher.

(3) If necessary, read the measurement directions that had been taped to the back of the clipboard.

(4) Administered the task.

(5) Put away the student sheet.

(6) Scored and graphed student data.

(7) Erased the acetate sheet.

(c) For spelling, she/he:

(1) Found the student sheet and placed it facing the student.

(2) Found the teacher sheet, covered it with the acetate sheet, and placed it facing the teacher.

(3) If necessary, read the measurement directions that had been taped to the back of the clipboard.

(4) Administered the task.

(5) Put away materials, placing the student sheet into a folder labeled "to be scored."

(6) Whenever convenient, scored and graphed student data.

(d) For written expression, she/he:

(1) Found the student sheet and placed it facing the student.

(2) If necessary, read the measurement directions that had been taped to the back of the clipboard.

(3) Administered the task.

(4) Put away materials, placing the student sheet into a folder labeled "to be scored."

(5) Whenever convenient, scored and graphed student data.

Over five weeks IRLD staff periodically observed teachers in these activities during both the workshops (simulated condition) and the classroom (natural condition). During two workshop observations, teachers were paired. Alternating roles, one teacher played the student while the other teacher administered measurement tasks. In the classroom observations, the teachers administered the measurement tasks to the same students for several weeks.

At the second workshop, teachers were taught to measure their own behavior using the above procedures and a reliability check was made by trained IRLD observers. Then, for the next two weeks, teachers observed their own behavior in the classroom with a reliability check conducted one week into their observations.

Results

Teacher efficiency was operationalized as time engaged in measurement. The range and median teacher time were calculated for (a) measurement preparation without student present, (b) measurement preparation with student present, and (b) the entire administration including directions, measurement task (standardized as one minute each for reading passages, reading lists, and spelling, and three minutes for written expression), and scoring and graphing.

Efficiency. A Wilcoxon Matched Pairs Signed Ranks Test was applied to the data and did not reveal a statistically significant difference between efficiency in the simulated and the natural conditions. However, teacher total time on the first trial (21 minutes, 42 seconds) was significantly different ($p < .05$) than teacher total time for the average of the other three trials (12 minutes, 48 seconds).

Insert Table 1 about here

Inspection of Table 1 reveals that efficiency for preparation time both with and without the student present followed the same pattern of results. Additionally, median teacher efficiencies within each trial on the different academic areas of measurement were similar for performances on directions, measurement task, and scoring/graphing in the two settings.

Reliability. Inter-rater reliability coefficients (shorter observer time/longer observer time) were calculated between the teachers' self-observations and the IRLD staff's observations of the teachers. Within the simulated setting, the coefficients ranged from .80 to .90 with a mean coefficient of .86. Similarly, within the natural setting, coefficients ranged from .70 to .94 with a mean coefficient of .85.

Additionally, reliability for various components of the measurement procedure (i.e., preparation time, directions, scoring and graphing) were all similar, the reliability within each component in both simulated and natural settings ranging from .75 to .94. Within each condition, the lowest reliability coefficient occurred in preparation time with student present. Within each of the academic areas, the reliability coefficients in both simulated and natural conditions were similar,

ranging from .80 to .93. Employing the criterion of .80 as an adequate coefficient, reliability in all instances except preparation time with the student present in the natural setting was acceptable.

Discussion

On the first trial when the procedure was initially taught, total teacher time engaged in measurement activities was 21 minutes, 42 seconds. On the following trial, however, teacher time dramatically dropped to 13 minutes, 47 seconds. This difference in teacher time between first and second trials appears to indicate that teachers quickly gained efficiency in measurement; within one week, they had significantly improved their efficiency by reducing the time required for preparation, administration, and scoring and graphing by nearly 50%. Nevertheless, an average of 12 minutes, 48 seconds per student (the total time for the average of the last three trials) represents a large portion of teacher time to spend in measurement activities. Furthermore, the efficiency data reported here do not include teacher time engaged in reading and analyzing graphs, important tasks if data are to be employed meaningfully. Therefore, this measurement format is even more time consuming than indicated by the figures reported in this study. Given the fact that these procedures appear to be time consuming for teachers, Studies 2 and 3 and the single case experiments, investigating logistical arrangements that improve teacher efficiency, appear warranted if a direct and repeated measurement system is to oe implemented practically by teachers.

Reliability. Teachers reliably measured their own behavior across different academic areas, in both simulated and natural conditions, and within various components of the measurement procedure, with the possible

exception of preparation time with student present in the natural setting. Therefore, to sample teacher behavior across occasions in order to better estimate teacher efficiency, it appears feasible to rely on teachers' self-monitoring of measurement activities. Based on these results, teachers' self-observations were employed in the remaining studies.

Study 2: Efficiency of Prescribed Order

Procedure

For one week (Phase A), given one student, teachers administered the measurement tasks in whatever order they preferred and each day completed the Observation Recording Sheet (see Appendix). For the following week (Phase B) given the same student, teachers administered the measurement tasks in a prescribed order. The order was designed to allow teachers to use the student's response time for the written expression measure (3 minutes) to score and graph previously administered tasks. The prescribed order was determined by the number of tasks administered on a given day. On days when two tasks were administered, the teachers:

-- Administered the spelling measure and reading lists in any order and scored/graphed whenever they preferred.

On days when three tasks were administered, the teachers:

(a) Administered the spelling measure, but did not score and graph at that time.

(b) Administered the reading lists, but did not score or graph at that time.

(c) Administered the written expression measure.

(d) While the student was writing, scored and graphed the spelling and reading measures.

(e) Scored/graphed the written expression measure at their convenience.

On days when four tasks were administered, the teachers:

(a) Administered the reading passage measure, but did not score/graph at that time.

(b) Administered the reading lists, but did not score/graph at that time.

(c) Administered the spelling measure, but did not score/graph at that time.

(d) Administered the written expression measure.

(e) While the student was writing, scored/graphed the reading and spelling measures.

(f) Scored/graphed the written expression measure at their convenience.

Teacher Survey 1, indicating their satisfaction with the prescribed order, was completed by the teachers on the day following the end of the experimental phase. Teacher Survey 2, indicating the actual order they currently were employing, was completed two weeks later.

Results

For each subject, an AB time-series analysis was applied to the average minutes per task that each teacher spent daily in preparing for and scoring and graphing the measures. Each teacher's daily total time was divided by the number of tasks administered and this average time per task was graphed. The time spent in the administration of the measurement tasks was not included as this time was held constant regardless of the order of measurement. Three of the ten possible subjects were excluded from this analysis due to an insufficient number of data points (0 or 1) in Phase A (where measurement tasks were given in any order the teachers chose). Replications across teachers were assessed to determine the generality of the effect of the prescribed

order on teacher efficiency. In addition, teacher satisfaction was assessed via the survey.

The graphs displaying average time per task for Phases A and B for each teacher were inspected by four IRLD staff members experienced in time-series data analysis. Figure 1 is one of the seven graphs inspected. Each staff member independently judged the difference between Phase A and B on each graph as an increase, decrease, no change, or undetermined. Reliability for judgments on each graph ranged from .5 (1 graph) to .75 (5 graphs) to 1.0 (1 graph). Reliability was high overall, with three out of four judges agreeing on all but one graph. For four of the seven graphs, minutes per task decreased; two were judged as no change, and judgments on the seventh graph were evenly split between decrease and undetermined. In addition, the mean net median change of minutes per task from Phase A (3.27) to Phase B (2.06) yielded a 37% decrease (a difference of 1.21 minutes).

Insert Figure 1 about here

On Teacher Survey 1, all teachers indicated satisfaction with the prescribed order. On a 1 to 4 scale (1 = very dissatisfied, 4 = very satisfied), all teachers rated their level of satisfaction as "satisfied." On Teacher Survey 2, in reporting the order of administration actually used, all teachers indicated use of the prescribed order.

Discussion

For four of the seven subjects, judges agreed that the prescribed order increased teacher efficiency. For two teachers, no change occurred and for one teacher the judges did not agree on the effect of the change.

The average difference between minutes per task in Phase A and Phase B was 1.21 minutes. Based on these results, it can be concluded that the prescribed order did increase teacher efficiency. Therefore, in order to increase efficiency, teachers can use the written expression student response time to score and graph other measures.

Teachers also reported that they were satisfied with the prescribed order and did indeed choose to follow that order after the experiment was over. Given the increase in efficiency and the teacher reported preferred and actual practice, the prescribed order appears to be a satisfactory change in the measurement proce re. Nevertheless, the procedures remained time consuming for teachers.

Study 3: Efficiency of When Measurement Occurs

Procedure

For one week (Phase A), given one student, teachers administered the measurement tasks at the middle or end of the instructional period, and completed the Observation Recording Sheet and the Student Transition Recording Sheet each day (see Appendix). For the following week (Phase B), given the same student, teachers administered the measurement tasks as soon as the student entered the room, and again completed the Observation Recording Sheet and the Student Transition Recording Sheet each day.

On the day following the last data collection time, teachers completed the teacher satisfaction survey (see Survey 2 in Appendix). Two weeks following that, teachers completed a survey indicating when, within the instructional period, they typically administered the measurement task (see Survey 3 in the Appendix).

Results

For each subject, an AB time-series analysis was applied to three of the dependent measures: (a) daily total teacher time in preparing for, implementing, and scoring and graphing the measures; (b) estimated daily student transition time; (c) estimated number of daily teacher prompts to student while making the transition from measurement to normal routine. Two subjects were dropped due to insufficient data. Replications across teachers were assessed to determine the generality of how the factor, when the measurement occurred, affected teacher efficiency and student transition efficiency. Additionally, the two surveys were summarized across teachers to provide descriptive data on teacher satisfaction.

For each teacher, efficiency data (total time in measurement) and student efficiency data (number of minutes in transition plus number of verbal prompts) were displayed on a graph from which the subject name was removed. (See Figure 2 for an example of one of these graphs.) Then IRLD staff, experienced in time-series data analysis, independently inspected each graph, and judged by which of the following categories teacher total time in Phase B was best described: increased, decreased, unchanged, or undetermined. Reliability across judges was high, with at least three of the four IRLD staff concurring on all but two of the graphs. Total teacher time in Phase B (measurement at the beginning of the period) decreased for only one subject and increased for three of the subjects. There was no change for two cases; for the other two subjects, judgments were split between two categories.

Insert Figure 2 about here

For each teacher the median estimated number of minutes the student spent transitioning to the next activity was calculated over Phase A and over Phase B; and for each teacher the net change in medians from Phase A to B was determined. Then, the net change was averaged across the teachers with a mean decrease of .31 estimated minutes. The number of verbal prompts from the teacher to the student in transition was summarized in an identical procedure, with a mean net median increase of .06 prompts.

On Survey 2, 5 of 10 teachers indicated that they preferred to measure as soon as the student arrived. One teacher reported that she preferred to measure part way through the student's time in the resource room. Three teachers responded that they preferred measurement at the end of the student's instructional period. One teacher did not respond.

On Survey 3, four teachers reported that they actually measured at the beginning of the period; two at the middle; none at the end. One teacher reported a variable schedule.

Discussion

For half the subjects, independent judges agreed that the variable "measuring at the beginning of the instructional period" had a controlling effect on teacher efficiency (operationalized as total time in measurement activities). Across those four subjects, however, the nature of that effect was unclear, with a decrease for one teacher and increases for three of the teachers. Given these inconsistent results along with the fact that there was either no change or the data were unclear for the other four subjects it appeared that, across teachers, measuring at the beginning of the period did not systematically control teacher efficiency.

Small mean net median changes from Phase A to Phase B for (a) the estimated number of minutes the student spent transitioning to the next activity (-.31), and (b) the number of verbal prompts from the teacher to the student during transition (+.06) corroborated the finding that measuring the student at the beginning of the period did not systematically affect efficiency in measurement.

Teachers most frequently reported, however, that they both preferred and actually implemented measurement at the beginning of the period. Therefore, teachers appeared more satisfied with measuring at the beginning of the instructional session.

Study 4: Single Case Efficiency Studies

Procedure

In a workshop setting, teachers were presented with the results of Studies 2 and 3. Teachers and IRLD staff then discussed changes that could be made in the measurement procedures to increase efficiency. A list of possible changes was generated, including:

(1) Use of tape recorders

(2) Use of computers

(3) Use of language master

(4) Use of a peer to conduct the measurement

(5) Use of a volunteer to conduct the measurement

(6) Different material preparation and organization schemes

(7) Using the student or a peer to score and graph data

(8) Using peer administration for spelling measurement

(9) Different procedures for selecting random samples as the stimuli for measurement

(10) Using students to prepare and organize materials

(11) Using students to score the correct and incorrect letter sequences in spelling

(12) Scoring and graphing only correct responses rather than correct and incorrect responses

After the list of changes was generated, teachers each chose a different factor to investigate. Eight single case studies were completed, each using an ABA reversal design. Each phase lasted approximately two weeks during which time approximately six data points were collected. The implemented treatments are listed in Table 2.

Insert Table 2 about here

Data Analysis

For each of the eight case studies, five categories of teacher efficiency were graphed: preparation time without student present; preparation time with student present; directions; scoring/graphing; and total time. For four of the cases (B, C, G, H), total time included an additional category of teacher efficiency, administration time. This category was not included in other studies because administration time was held constant (one minute for spelling, reading in context, and reading isolated words) and therefore was not affected by the efficiency factors. However, in studies B, C, G, and H, the treatments eliminated teacher time spent in administration so the one minute administration time was included in the total time baseline phases.

Each teacher's self-observed timings for each of the categories were plotted for the three phases. Four staff members of the IRLD, experienced in time-series analysis, judged each treatment phase as effective, ineffective, or unclear on the five categories of teacher

efficiency for each of the eight subjects. Therefore, each rater made 40 decisions. Interrater reliability was computed for the four judges by dividing the number of agreements by the number of possible agreements. Of the 40 cells, reliability was 100% for 28 cells, 75% for seven cells, and 50% for five cells. In other words, 70% of the judgments were identical; for all judgments, at least half of the raters agreed.

Results

Efficiency. In case studies A, B, C, and D, the change in measurement procedures clearly reduced teacher time. (See Figures 3-6 for graphs of these studies.)

Insert Figures 3-6 about here

In the first modification of the measurement procedure (Study A), the teacher precounted the number of words in the section of the book the student read for measurement purposes as opposed to counting the words read after the administration. This change in procedures increased the teacher's time spent in preparation without the student present from 0 to 35 seconds but decreased time spent scoring/graphing from a median of 50 seconds per task to 2 seconds per task. Total teacher time in measurement, excluding the one minute administration, was reduced from a median of 62.5 seconds per task to 44.5 seconds per task.

In Study B, a second modification in measurement procedures that reduced teacher time was investigated; specifically, the teacher taught the student to score and graph the Reading in Context and Reading in

Isolation measures. The time spent in instructing the student in these procedures was recorded under the scoring/graphing category. Initially, scoring/graphing time increased dramatically, but then returned to a level as low or lower than the median time recorded before the change. Total time dropped from a median of 87 seconds per task to 47. Upon return to baseline (teacher scoring and graphing) median total time increased to 58 seconds per task.

In the final two studies in which teachers clearly increased efficiency, both teachers used mechanical devices to administer the measurement tasks. In Study C, the teacher used a language master to administer the spelling measure individually to three children. During baseline phases the teacher had personally administered the spelling measure to each of the three students; each administration taking one minute per student. During the treatment phase, each child listened to the spelling words via the language master and therefore, the teacher saved the one minute administration time per student. The median total time for each phase was 130 seconds (teacher administration), 56 seconds (language master), and 85 seconds (teacher administration), respectively.

The mechanical device used in Study D was a tape recorder. During the treatment phase, instead of reading a passage to the teacher, the student read for one minute into a tape recorder. With this change in the measurement procedure, the teacher saved the one minute administration time. The median total time per task for the three phases was 139.5 seconds (teacher listens), 88 seconds (tape recorder listens), and 73 seconds (teacher listens). The change in procedures cut the total measurement time in half; when the teacher

returned to baseline, there appeared to be some carryover effect.

In Study E, although the results were less clear, it appeared that efficiency was increased (see Figure 7). In this case, the change consisted of administering the spelling measure to two children at once instead of individually. Median total time was reduced through each of the three phases from 188 seconds in Phase A (individual administration) to 137 seconds in Phase B (small group administration), and then back to 59 seconds in Phase A (individual administration). The carryover of the treatment effect when returning to baseline made the results difficult to interpret.

Insert Figure 7 about here

In case studies F and G, the change in the measurement procedures involved the use of a peer tester or an aide to administer the measurement tasks. Neither study resulted in increased efficiency. In both cases, teachers spent an inordinate amount of time training the peer or the aide to conduct measurement. Preparation time with and without student present and scoring/graphing time were increased during the treatment phase. Therefore, even though the teachers saved themselves one minute of administration time, the increased time in the other categories negated any maximization of efficiency. For the study involving the peer tester, the median total times per task were 160, 209, and 160 seconds for the three phases, indicating reduced efficiency. Median total time per task stayed fairly consistent across phases (110, 120, and 118 seconds) in the study conducted with the aide as the measurement administrator.

In the final case study (H), the teacher switched from daily preparation of measurement materials during baseline to preparing the measurement materials for the entire week at one time. The only category of teacher time that could be affected directly by this change was preparation without student present. However, the median times (40, 46, 45) reflected no difference in this category or in any other, including total time. This change in preparation strategy did not affect the teacher's efficiency.

To summarize, in five of the eight case studies, teacher efficiency increased. The changes in measurement procedures that increased efficiency included: (a) precounting oral reading passages; (b) using mechanical devices to administer the measurement tasks (language master for spelling and tape recorder for oral reading); (c) training the student to score and graph his/her own data; and (d) administering the measure to more than one student at a time instead of individually. The three studies in which the changes failed to improve efficiency involved the use of peer tester or aides in administering the measures and weekly versus daily preparation of measurement materials.

Teacher satisfaction. Teachers were asked to respond to three questions about the changes made in measurement procedures:

(1) How would you describe the effect of the change on your efficiency, your student(s), or any other factors?

(2) What are the advantages of this change?

(3) What are the disadvantages of this change?

The teachers' responses are summarized in Table 2. Some of the advantages mentioned by teachers included more time for instruction and increased motivation for the student. Disadvantages included increased

preparation time, student inconvenience, and less chance to conduct an error analysis of the student's performance when someone else administered the measurement task.

Discussion

The results of these case studies indicated that the teacher's time spent in measurement can be reduced. Procedures that seemed useful in increasing efficiency included precounting the words in oral reading passages, group administration, using mechanical devices to administer the measures, and teaching the student to score and graph measurement results. Using peer testers or aides to administer the measurement and preparing measurement material in bulk did not increase efficiency. However, if the treatment phases in these case studies had been expanded, increased efficiency may have been noted. In all three of these studies, the treatment phase consisted of only four or five data points, whereas the baseline phases ranged from 5 to 14 data points. In addition, during treatment a steep decreasing slope was noted in all cases. Had a longer treatment period been initiated, the desired effects might have been obtained.

Study 5: A Follow Up of Teacher Efficiency

Procedure

For the remainder of the school year (February through May), the 10 teachers implemented whatever strategies they preferred in order to maximize their efficiency. In May, approximately nine months after initial training on the measurement procedures, teachers measured their own behavior to determine how much time they typically spent in measurement activities.

Additionally, in January, a group of five suburban teachers was trained to prepare, direct, administer, score, and graph the same measurement tasks by reading self-instructional manuals and by participating in several inservices. These teachers were observed twice in order to assess their efficiency. Unlike the procedure for the rural teachers, no training or systematic manipulations for improving efficiency were implemented. In May, approximately five months after they had been trained in the measurement procedures, this contrast group of teachers monitored their own measurement activities to arrive at a time representative of their end-of-year efficiency.

Results and Discussion

The mean time per task for each teacher was calculated. Then, for each group of teachers, these mean times were averaged. (In all cases, administration time was not included.) At the end of the year, the 10 rural teachers, who had been personally and intensely trained and systematically prompted in methods for improving efficiency, spent an average of 61 seconds in measurement for each task. In contrast, the group of teachers who had been trained via a manual and inservices, and instructed only verbally to improve their efficiency in whatever ways they chose, spent an average of 15 minutes per task in preparing, directing, scoring, and graphing. This year-end measurement time was much longer than the median measurement time obtained in January, which was two minutes and 21 seconds per task. Therefore, the unprompted group experienced a reduction in efficiency at the end of the year, performing 15 times less efficiently than the prompted group.

It might be argued that the wide discrepancy between the times

of the two groups of teachers is a function of the difference in the number of months of practice rather than a function of the group different training histories. The prompted group spent an entire school year in measurement; the unprompted group spent only five months of the school year in measurement. However, comparing the two groups at the points where each had experienced a comparable four or five months in measurement, a large discrepancy remained. In January, the 10 prompted teachers spent an average of 124 seconds per task in measurement activities; in May, the five unprompted teachers spent an average of 15 minutes per task. The prompted group was 600% more efficient than the unprompted group, even when the number of months of practice time was held constant across the two groups. In fact, the unprompted group showed a decrease in efficiency time.

Moreover, at the end of five months, the group trained by a manual and inservices was performing more than three times less efficiently (15 minutes) than the personally trained group performed initially (3 minutes, 26 seconds). This suggests that on-going, face-to-face training, along with specific instruction in methods for improving efficiency may be critical if teachers are to develop efficient measurement strategies.

Obviously, there were other important differences between the groups of teachers that might account for the discrepancies. For example, the prompted group was rural while the unprompted group was suburban; the prompted group was required to participate while the unprompted group volunteered. Nevertheless, the prompted group's

performance throughout the year provides clear evidence that properly trained and prompted teachers can improve their efficiency dramatically. On the first trial the prompted group of teachers spent a median of 4 minutes, 26 seconds in measurement per task; after two trials they spent 2 minutes, 30 seconds, and by the end of the school year, that time had been reduced to 1 minute, 1 second.

Conclusion

In this research, teachers demonstrated that they reliably measure the time in which they are engaged in measurement activities. The analysis of their observations revealed that teachers initially required approximately 13 1/2 minutes to prepare, administer, and score and graph measurement tasks on four academic behaviors for one student. Given frequent measurement and the number of children typically on their caseloads, this time commitment becomes quite burdensome. As a result, an increase in the efficiency of the measurement procedures is critical if frequent measurement within the classroom is to be more feasible.

Therefore, Studies 2 and 3 and a series of single case studies (Study 4) investigated the effects of various factors on the efficiency of measurement and teacher satisfaction. The first factor (Study 2) was a prescribed order consisting of the administration of the reading and spelling tasks prior to the written expression task. This sequence allowed the teachers to use the three minutes of student response time for written expression to score and graph the reading and spelling measures. Prior to the experimental phase, teachers had administered the tasks in whatever order they preferred and typically had been unoccupied while the student responded to the three minute

written expression measure. The prescribed order did increase slightly the efficiency of measurement and was satisfactory to the teachers.

The second factor (Study 3), the scheduling of the measurement tasks, required the teachers to change from a phase in which they measured the students at the middle or end of the period to a phase in which they measured at the beginning of the period. Although no clear results were reported for efficiency, teachers were more satisfied with the latter schedule.

The results of the single case studies (Study 4) suggested that other factors may also be effective in increasing teacher efficiency. Among the most effective factors were precounting the words in oral reading passages, group administration, using mechanical devices to administer the measures, and teaching the student to score and graph measurement results. Further investigations of these as well as other efficiency factors appear warranted.

Study 5 contrasted these teachers' efficiency with the efficiency of a group of teachers who had been trained via a self-instructional manual and periodic inservices and who had been less thoroughly prompted to improve their efficiency. Results of Study 5 indicated that personal training along with systematic training in efficient procedures may be critical for developing efficient teacher measurement behavior.

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Table 1

Teacher Time in Administering SMT in Simulated and Natural Conditions

	Simulated[a] (Week 1)	Natural[b] (Week 2)	Simulated[c] (Week 3)	Natural[d] (Week 4)
Directions + Measurement Task + Scoring/Graphing				
Reading Passages				
Range	1'25" - 2'45"	1'18" - 2'16"	1'30" - 1'55.5"	1'29" - 2'01"
Median	1'55"	1'48"	1'46.5"	1'47"
Reading Lists				
Range	1'20" - 3'56"	1'16" - 2'47"	1'41.5" - 1'48.5"	1'20" - 2'02.5"
Median	1'41.5"	1'58.5"	1'44.3"	1'49.5"
Spelling				
Range	2'55" - 6'55"	1'3" - 4'10"	2'23" - 3'33"	1'42" - 2'51"
Median	2'50"	2'42"	3'06.5"	2'32"
Written Expression				
Range	3'27" - 7'55"	3'23" - 7'5"	3'37.5" - 4'29.5"	3'39.5 - 4'55.5"
Median	4'37.5"	4'52.5"	3'58"	3'51"
Preparation Time with Student Present				
Range	0'0" - 5'32"	0'0" - 4'35"	0'0" - 0'60"	0'52" - 1'37.5"
Median	2'9"	1'17"	0'24"	1'16"
Total Time with Student Present				
Range	11'32" - 21'52"	7'24" - 17'25"	9'12" - 11'6"	8'54" - 13'30"
Median	15'47"	12'26.5"	0'24"	11'18"
Preparation Time without Student Present				
Range	0'0" - 10'26"	2'1.5" - 3'1.4"	0'50" - 3'34"	1'54" - 5'02"
Median	4'15"	2'20.4"	2'36"	2'05"
Total Time				
Range	14'32" - 22'12"	11'48.8" - 16'48.8"	9'54"- 12'20"	11'19" - 16'20"
Median	21'42"	13'47.5"	10'54"	13'36"

[a] N = 6

[b] N = 10

[c] Entries are based on different subjects and different numbers of subjects (max N = 10). Subjects were assigned to prepare and administer only two measurement tasks. The times indicated are an average of the subject's and observer's times.

[d] N = 7

Table 2

Summary of Single Case Studies

Study	Change	Effect on Efficiency	Teacher's Response	Advantage	Disadvantages
A	Baseline - words counted during scoring/graphing Treatment - words precounted in reading selections	Increased	Quicker to score and graph	Too less time	None
B	Baseline - teacher scores and graphs reading measures Treatment - student does own scoring and graphing for Reading in Context and Reading in Isolation	Increased	Student was motivated	Student liked to see data plotted on graph	More time comsuming
C	Baseline - teacher individually administers spelling measures Treatment - language master used to administer spelling tasks	Increased	Increased efficiency	Provided opportunity for increased time in 1 to 1 instruction	Required more preparation
D	Baseline - student reads to teacher for reading in context measurement Treatment - student reads into tape recorder for Reading in Context	Increased	Decreased efficiency	Allowed more class time with students Some motivating effect	Time spent after school in scoring/graphing increased
E	Baseline - measure students individually Treatment - measure two students at once in spelling	Mixed	One student had to wait while other was still spelling	None	Student had to wait for the other to catch up
F	Baseline - teacher conducts measurement Treatment - aide administers measures	No change	Not very efficient	Teacher did not have to take time to administer measures	Required teacher time to explain procedures to aide
G	Baseline - teacher conducts measurement Treatment - peer tester administers measures	Decreased	More efficient	Motivated student	Less chance to see student errors
H	Baseline - daily measurement preparation and organization Treatment - measurement materials prepared once weekly	No change	No change	None	None

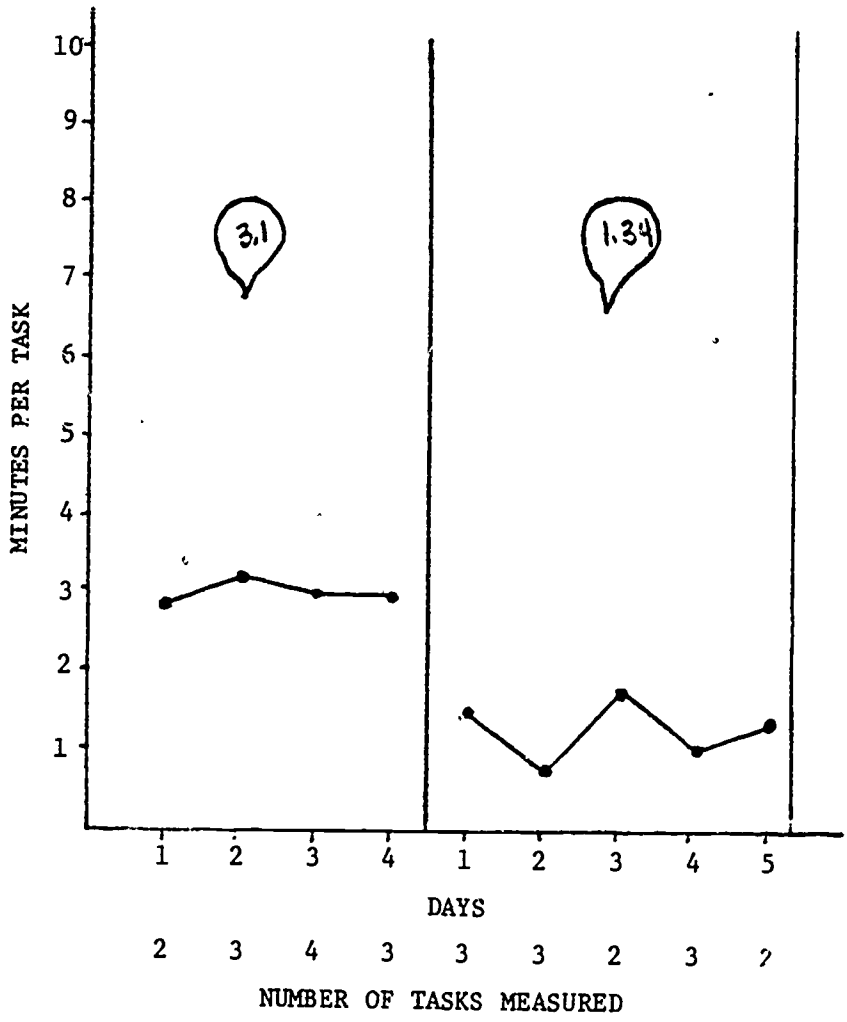

Figure 1. Time-Series Data for Subject 1, Study 2

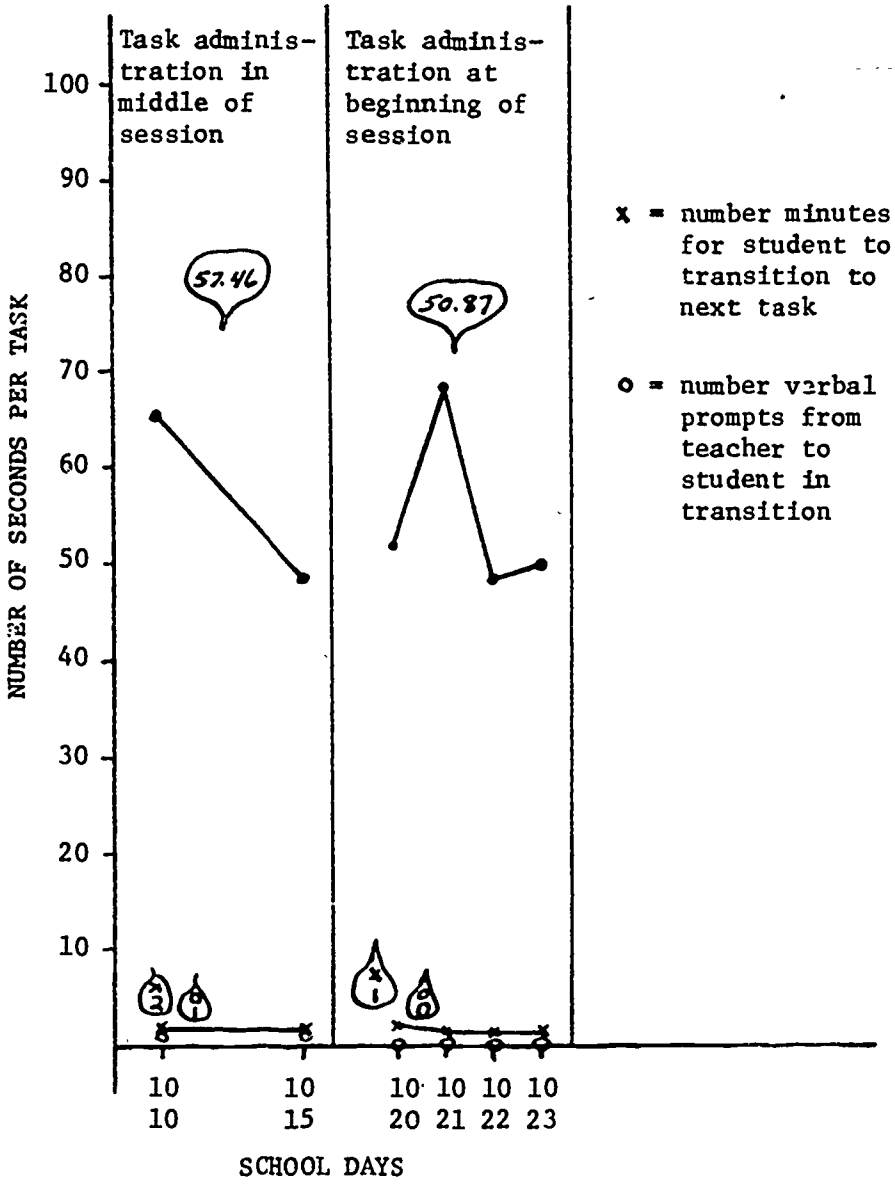

Figure 2. Time-Series Data for Subject 8, Study 2

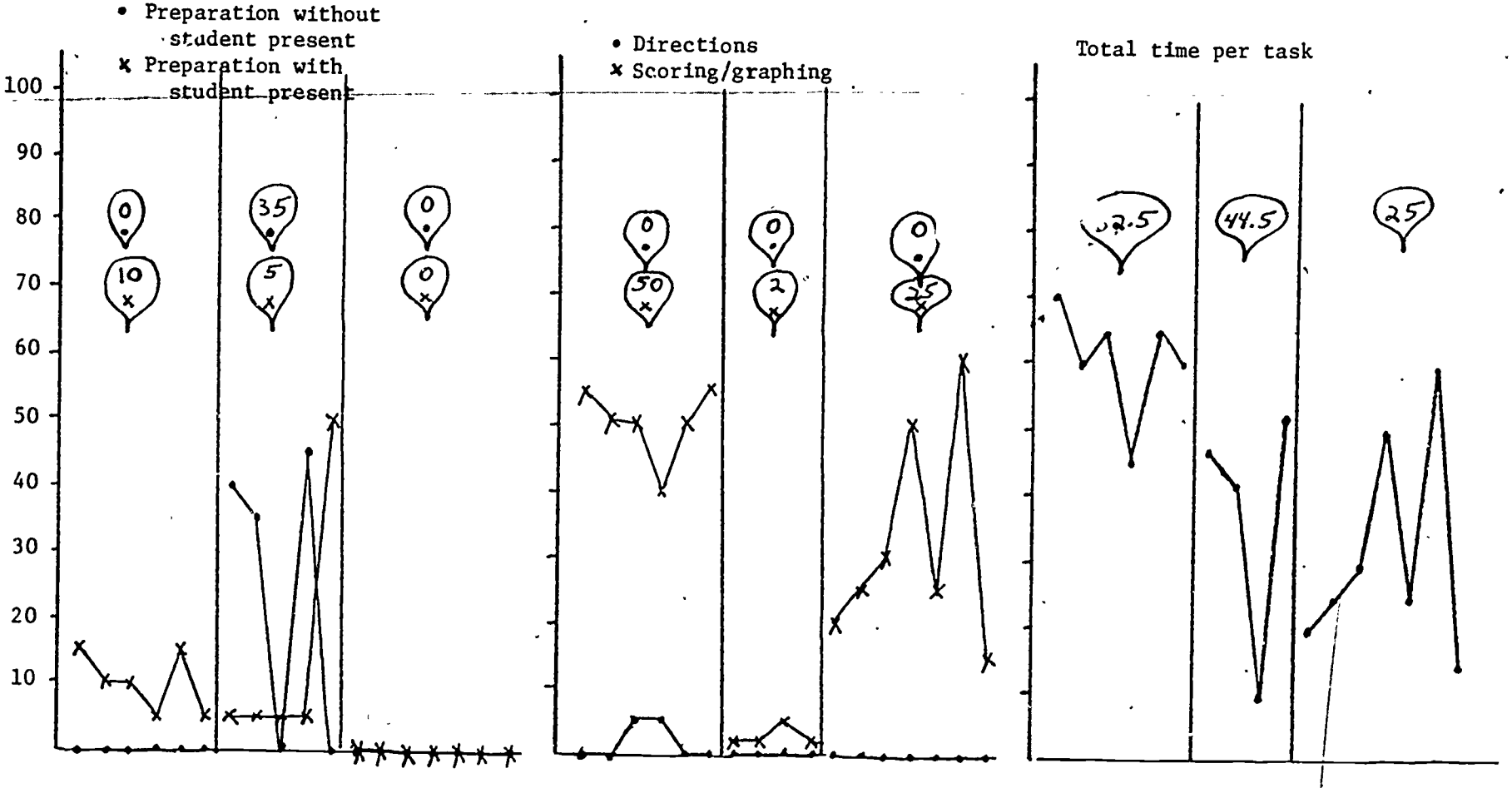

Figure 3. Time-Series Data for Single Case Study A

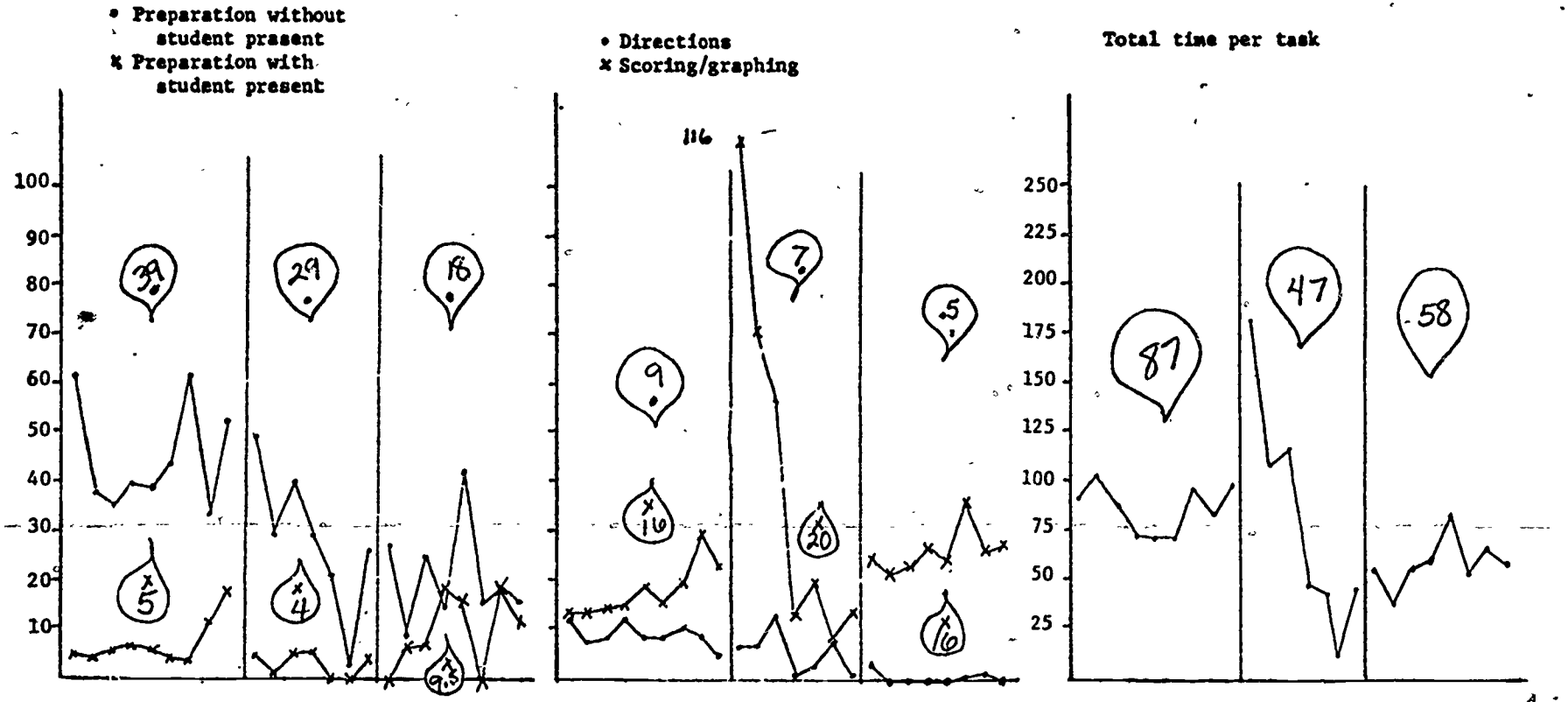

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Figure 4. Time-Series Data for Single Case Study B

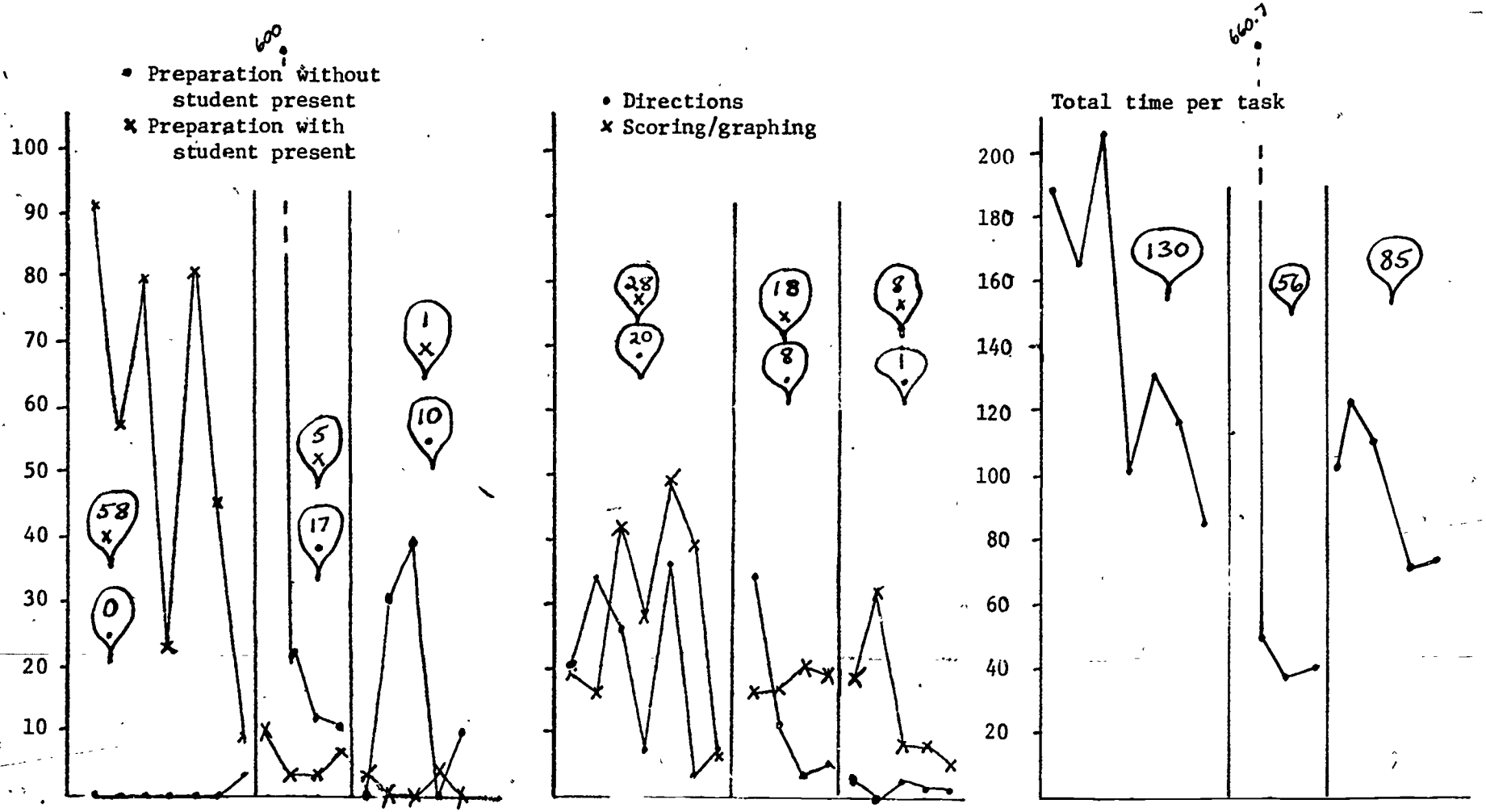

Figure 5. Time-Series Data for Single Case Study C

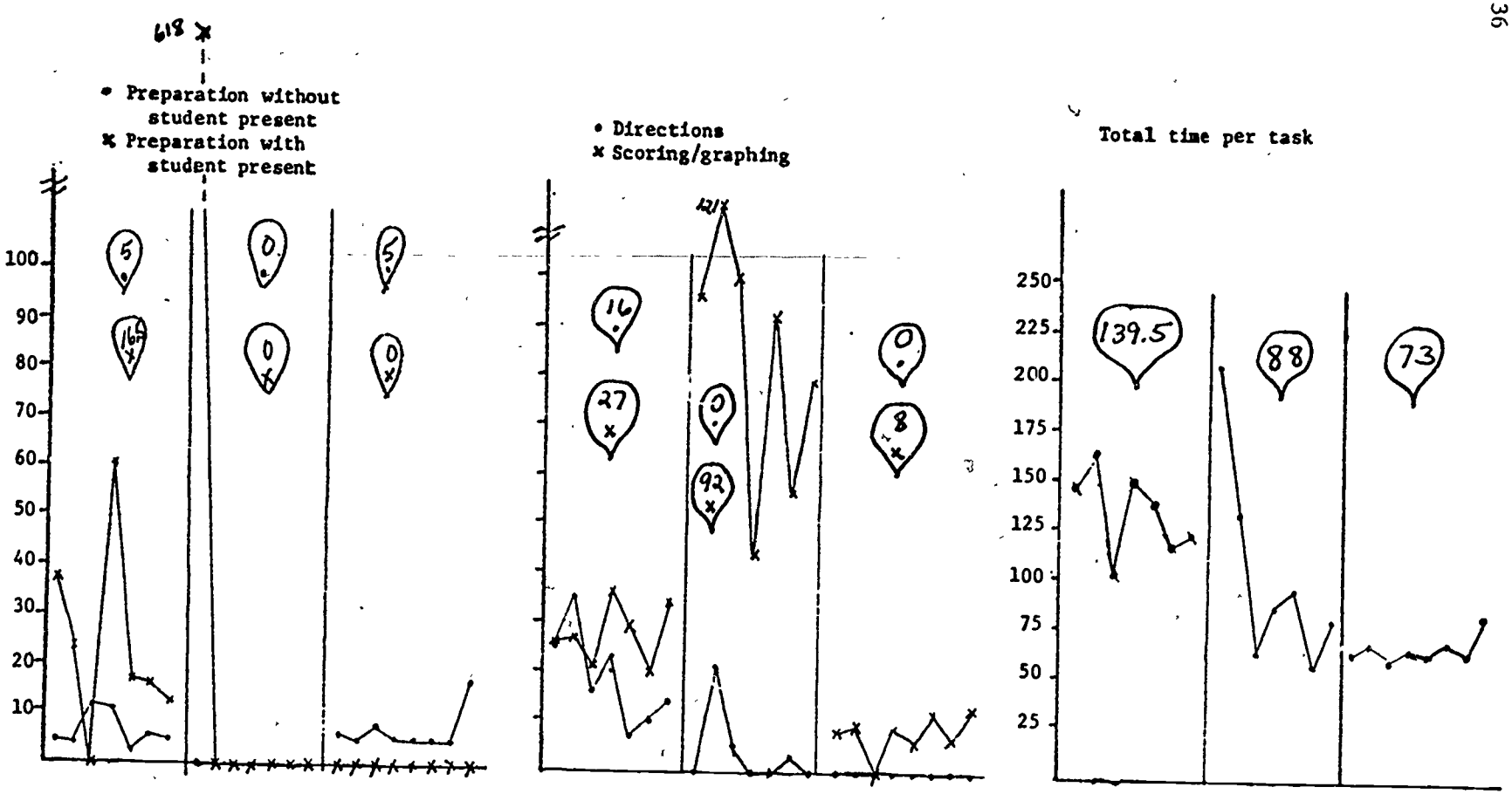

Figure 6. Time-Series Data for Single Case Study D

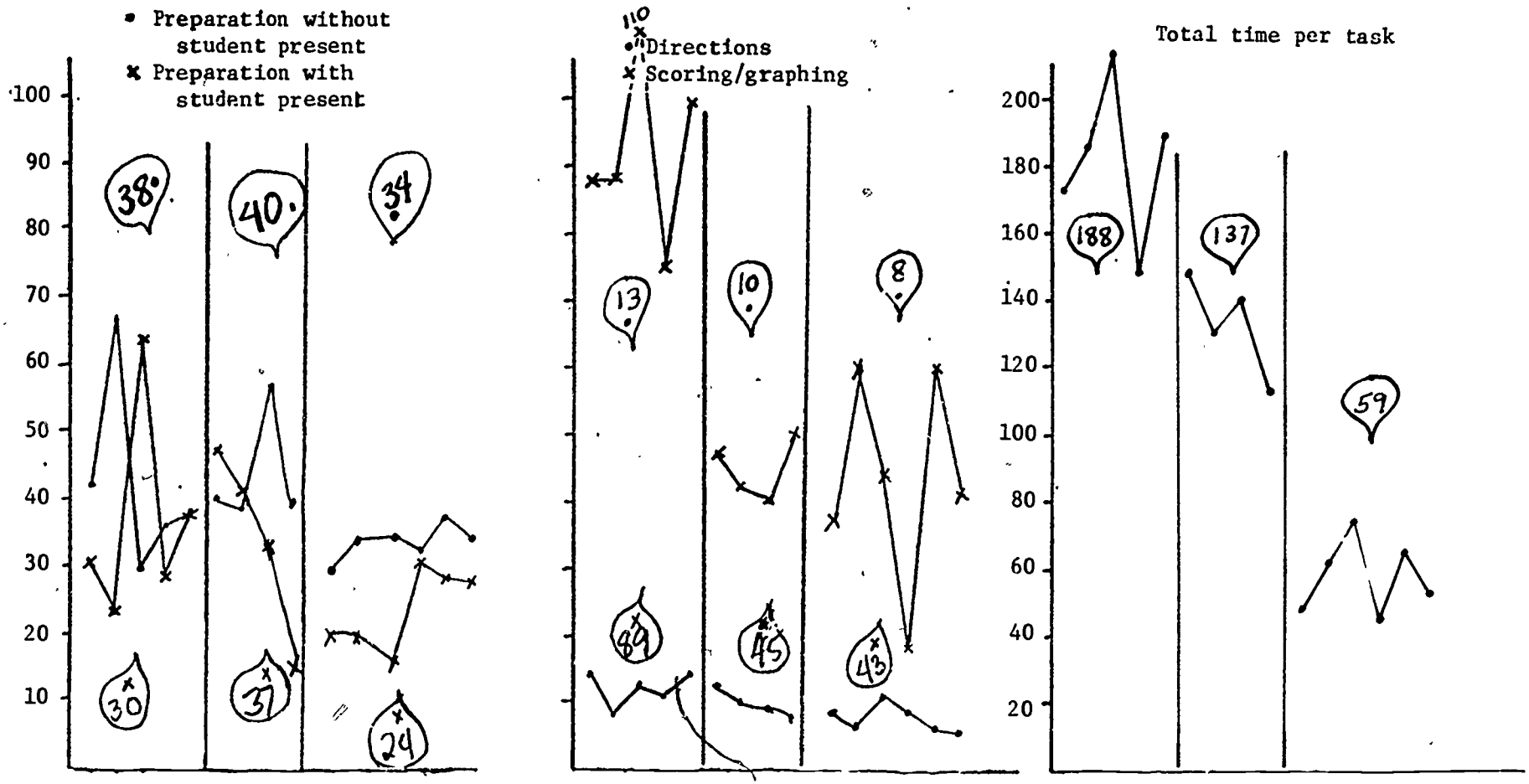

Figure 7. Time-Series Data for Single Case Study E

APPENDIX

Student Transition Recording Sheet

Measure the same student for these two weeks.

Estimate how long it took the student to begin a new activity after you finished measuring him/her. Circle one.

less than 1 min. 1 min. 2 min. 3 min. 4 min. 5 min. 6 min.

7 min. 8 min. 9 min. 10 min. more than 10 min.

Estimate how many times you reminded the student to begin his/her new activity.

_____
(# of times)

When within the instructional period did measurement occur? Circle one.

beginning

middle

end

other _____

Teacher Survey 1

1. During this past week, while timing how long it took you to administer the kit, please provide the following information:

Student's name	How many times did you administer each of these tasks? Spelling	Reading Passages	Reading Isolated Words	Written Expression
_____	____	____	____	____
_____	____	____	____	____
_____	____	____	____	____
_____	____	____	____	____
_____	____	____	____	____

2. How easy is it to time yourself while administering the kit?

Very difficult	Difficult	Easy	Very Easy
1	2	3	4

3. **In administering the kit last week, rate your level of satisfaction with the prescribed order.**

Very dissatisfied	**Dissatisfied**	**Satisfied**	**Very satisfied**
1	2	3	4

To what degree did each of the following factors contribute to your level of satisfaction?

Low			High	
1	2	3	4	How the prescribed order affected your speed in administering the tasks.
1	2	3	4	How the prescribed order affected your accuracy in scoring the tasks.
1	2	3	4	How the prescribed order affected the amount of time the student spent waiting.

Teacher Survey 2

1. During this past week, while timing how long it took you to administer the kit, please provide the following information:

Student's name	How many times did you administer each of these tasks? Spelling	Reading Passages	Reading Isolated Words	Written Expression
_____	____	____	____	____
_____	____	____	____	____
_____	____	____	____	____
_____	____	____	____	____
_____	____	____	____	____

2. When you administer spelling and reading isolated words, what order of administration do you usually use?

   First_____

   Second_____

3. When you administer spelling, reading isolated words, and written expression, what order of administration do you usually use?

   First_____

   Second_____

   Third_____

4. When you administer all four measures (spelling, reading isolated words, written expression, and reading passages), what order of administration do you usually use?

   First_____

   Second_____

   Third_____

   Fourth_____

Teacher Survey 3

1. Please provide the following information about how many tasks you administered from the kit to the research student in the past two weeks:

Student's name	How many times did you administer each of these tasks? Spelling	Reading Passages	Reading Isolated Words	Written Expression
_____	_____	_____	_____	_____

2. Please provide the following information about when you administered the measurement tasks during the past two weeks ending 11/5 (either from the kit or your own materials) and the IEP areas in which you are measuring and instructing:

Student's name	IEP areas of measurement and instruction	How many times did you administer a measurement task at each of these times? Beginning of the period	Midddle of the period	End of the period
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. Rate the usefulness of the measurement results that you have collected from the students.

very useful	moderately useful	somewhat useful	not at all useful
4	3	2	1

4. How have you used the information that you collected through measurement?

_____

_____

_____

_____

5. Assuming that your students had IEP goals in each of the measurement areas, please rate your satisfaction with the following features of the Standard Measurement Kit.

	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
The packaging and organization of the kit	1	2	3	4
The clarity of the directions	1	2	3	4
The schedule of administration	1	2	3	4
The spelling measurement format	1	2	3	4
The written expression measurement format	1	2	3	4
The reading-in-context measurement format	1	2	3	4
The reading isolated words measurement format	1	2	3	4

6. How useful did you find having prepared measurement materials for the first month of data collection?

Very Useful	Moderately Useful	Somewhat Useful	Not at all Useful
1	2	3	4

7. How do you think the kit should be modified?

_____

_____

_____

_____

8. With what aspect(s) of the kit were you most pleased?

_____

_____

_____

_____

9. When do you prefer to administer the kit to the student?

_____As soon as the student arrives.

_____Part way through the student's time in the resource room.

_____At the end of the student's time in the resource room.

Teacher Observation Recording Form Name_____ Date_____

PREPARING WHILE STUDENT IS NOT PRESENT

TIME: [#STUS:] TIME: [#STUS:] TIME: [#STUS:]

TIME: [#STUS:] TIME: [#STUS] TIME: [#STUS:]

PREPARING WHILE STUDENT IS PRESENT

TIME: [#STUS:] TIME: [#STUS:] TIME: [#STUS:]

TIME: [#STUS:] TIME: [#STUS:] TIME: [#STUS:]

GIVING DIRECTIONS

READING IN CONTEXT	READING IN CONTEXT	SPELLING	WRITTEN EXPRESSION
TIME: [#STUS:]	TIME: [#STUS:]	TIME: [#STUS:]	TIME: [#STUS:]

SCORING & GRAPHING TIME: TIME: TIME: TIME:

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